Letter from Alexander Graham Bell to Marian Bell Fairchild, January 3, 1901

12 Volta Bureau, Washington, D. C., January 3, 1901. My dear Marian: —

I have just unearthed from your mother's bag your nice letter of December 16, 1900. I wondered whether my note relating to whiskey bottles — drinking water, &c. would stimulate you to make an experiment, and I find it has, and you have found by experience that it is more easy to get results upon paper than by actual experiment.

I showed a copy of my two letters to you to Dr. Phelps — the young doctor who took charge of the sheep experiments in Baddeck during my absence abroad. He seemed much interested and said he would try some experiments upon the subject. I have since received two notes from him showing that his interest continues and that he is beginning to obtain results. I send you typewritten copies of his two notes, dated Dec. 10 and Dec. 23. From his second letter you observe that he has actually produced 90 cubic centimeters of “perfectly fresh, sweet water” from salt water heated only to the temperature of the human body (about 99 degrees F.) with a condensing chamber cooled to about the temperature of the ocean (55 degrees F.) This result is encouraging, showing that the principle is all right — and demonstrating that the condensing process is continuous. I enclose a carbon 2 13 copy of my letter to him, and now I will continue notes for our mutual benefit.

I don't agree with you that “there is nothing now but to discuss a practical apparatus for doing the deed”, and I am therefore still collecting ideas upon the subject by reading. I have been looking over a book entitled “The Theory of Heat”, by J. Clark Maxwell, with corrections and additions by Lord Rayleigh: — London, Longman Green & Co., and New York, 15 E. 16th Street, 1894, and send you a few gleanings,

p. 22 “When a liquid or a solid body is placed in a vessel the rest of which is empty, it gives off part of its own substance in the form of gas. This process is called evaporation, and the gas given off is commonly called the vapor of the solid or liquid substance. The process of evaporation goes on till the density of the vapor in the vessel has reached a value which depends only on the temperature.

If, in any way, as by the motion of a piston, the vessel be made larger, then more vapor will be formed till the density is the same as before. If the piston he pushed in, and the vessel be made smaller, some of the vapor is condensed into the liquid state, but the density of the remainder of the vapor still remains the same.

If the remainder of the vessel instead of containing nothing but the vapor of the liquid, contains any quantity of air, or some other gas not capable of chemical action on the liquid, then exactly the same quantity of vapor will be formed, but the time required for the vapor to reach the further parts of the vessel will be greater, as it has to diffuse itself through the air in the vessel by a kind of percolation. These laws of evaporation were discovered by Dalton.”.....

p. 23 “A vapor which is at the greatest density and pressure corresponding to its temperature, is called a saturated 3 14 vapor. It is then just at the point of condensation, and the slightest increase of pressure, or decrease of temperature, will cause some of the vapor to be condensed”.....

p. 26 “If water at a temperature below 100° C. be placed in a vessel, and if by means of an air pump we reduce the pressure of the air on the surface of the water, evaporation goes on and the surface of the water becomes colder than the interior parts. If we go on working the air pump the pressure is reduced to that of vapor of the temperature of the interior of the fluid. The water then begins to boil exactly as in the ordinary way, and as it boils the temperature rapidly falls, the beat being expended in evaporating the water.” &c.

In my note of November 29 & 30 , I treated the subject from the point of view of DAMPENED AIR, and how to wring the moisture out of it. In my note of December 19 we considered aqueous vapor as a gas, tending to expand indefinitely an completely fill any vessel in which it may be placed: The above quotations suggest another line of thought — THE REMOVAL OF ATMOSPHERIC PRESSURE by pumping out the air over the water, that is: — the removal of the air above the water, so as to leave the aqueous vapor alone to fill the empty space.

Every boat is, or should be provided with a pump for ba i ling purposes: — Wouldn't it be a curious thing if we could pump out the fresh water from a body of salt water and leave the salt behind: By pumping out the air over the salt water we promote evaporation and the empty space formerly occupied by the air 4 15 will soon be occupied by aqueous vapor at the density, or pressure which can be supported by the temperature of the water. If then we pump out the aqueous vapor the space will soon be re-filled by fresh evaporation from the water, &c., &c.

By a reverse action of the pump the aqueous vapor which has been removed from the space above the water could be compressed in a cooled receiver, where some of it would be condensed into water; T hus by a sucking action on the surface of the salt water we would rob it of vapor, and by a compressing action we could put the vapor into the cooled receiver in a better condition for condensation.

I want now to read up the subject of “the liquifaction of gas s es.”. We can surely gain some ideas from the processes employed in liquifying the more refractory gas s es, like oxygen nitrogen, hydrogen, &c. especially as these processes involve low temperature, not high. p P erhaps you can get me some information upon this subject in France, as the earlier experiments were made by Frenchmen. I recall especially the name of “Pictet” I believe he is still living in Paris.

I have two scientific friends in Paris, who, I am sure, would be glad to give you any information upon the subject: — Prof. Poincaree, Secretary, I think, of the Societe de Physique, and Prof. Lippman. Both are celebrated men, and you can easily obtain 5 16 their addresses. You might write to them for the titles of Scientific papers upon the liquifaction of gas s es, and you could then hunt up the papers in the Bibliotheque Nationale, and send me any extracts that you think bear upon our problem

Your loving father Alexander Graham Bell P.S. & answer arrived safely four days ! The the takes place Sunday. Love & AGB